S3/S4 Homework Exercises

Dynamics and Space Homework One

1. Copy and complete the following sentence.

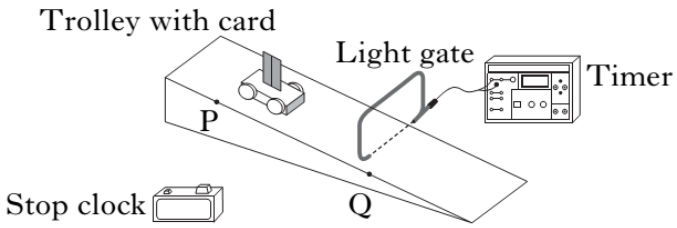
"Using a stopwatch to measure time and a t_____ w_____ to measure distance it would be possible to measure the a_____ speed of a vehicle."

(2)

2. Calculate the average speed of a car which travels 240 m in 15 seconds.

(3)

3. A student investigates the speed of a trolley down a slope.



The measurement recorded from the investigation are shown below.

Distance from P to Q = 1.0 m

Length of card on trolley = 4 cm

Time taken for trolley to travel from P to Q = 2.5 s

Time taken for card to pass through light gate = 0.05 s

Calculate the instantaneous speed of the trolley at point Q.

(3)

4. Construct a table to classify the following terms as vector or scalar.

displacement *distance* *energy* *force* *speed* *velocity*

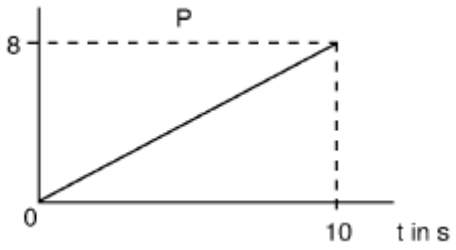
(2)

5. Explain the difference between a vector quantity and a scalar quantity.

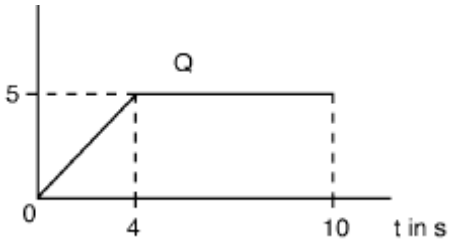
(2)

6. Shown below are the speed - time graphs for three boys – P, Q and R – involved in a race against each other.

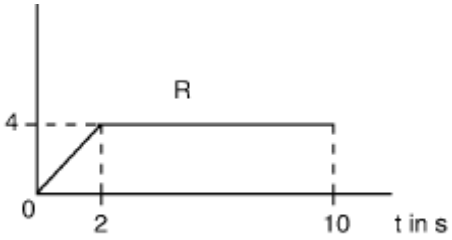
speed in ms^{-1}



speed in ms^{-1}



speed in ms^{-1}



a) Which boy maintained a constant acceleration throughout the race?

(1)

b) Which boy maintained a constant speed for the longest time?

(1)

c) Which boy was travelling fastest after 4 seconds?

(1)

d) By calculation, show whether Q or R, travelled a greater distance in 10 s.

(5)

Dynamics and Space Homework Two

1. Draw the speed-time graph (you must use a ruler) described by these statements:-

The object starts from rest and accelerates for 5 seconds reaching a final speed of 12 ms^{-1}. The object then continues at 12 ms^{-1} for another 8 seconds. The object then slows down to rest in 7 seconds.

(4)

2. Explain how you would use the following apparatus to find the acceleration of a trolley.

Ramp *Two light gates* *Computer* *Trolley with card on top*

Your description should clearly show an understanding of any necessary equations.

(4)

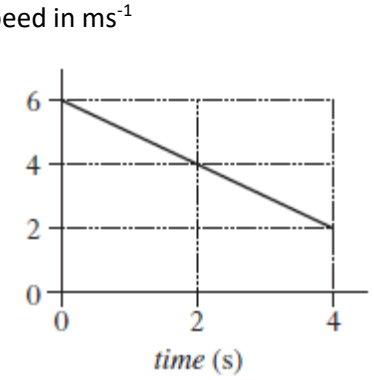
3. A train starts from rest and reaches a speed of 15 ms^{-1} in 20 seconds. Calculate the acceleration of the train.

(3)

4. For the first 0.8 s of its motion, the acceleration of a bowling ball is 2 ms^{-2}. Assuming it started from rest, calculate its speed after 0.8 s.

(3)

5. The graph below shows how the speed of a ball varies with time.



Calculate the acceleration of the ball.

(3)

6. A sports car accelerates at 4 ms^{-2}. During the acceleration the speed of the sports car changes from 13 ms^{-1} to 27 ms^{-1}. Calculate the time over which the car accelerates.

(3)

Dynamics and Space Homework Three

1. Describe two situations where frictional forces are increased to slow down a moving object.

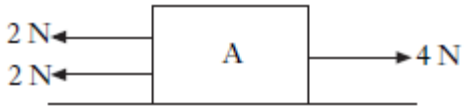
(2)

2. Describe one way in which frictional forces can be decreased in car design.

(1)

3.

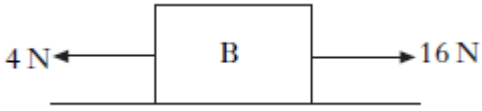
a) Use the diagram below, to copy and complete the following sentences.



"The forces on block A are (balanced/unbalanced). This means the block will be (moving with a constant speed/accelerating)."

(2)

b) Use the diagram below, to copy and complete the following sentences.



"The forces on block B are (balanced/unbalanced). This means the block will be (moving with a constant speed/accelerating)."

(2)

4. A sprinter of mass 80 kg accelerates at 10 ms^{-2}. Calculate the unbalanced force needed to produce this acceleration.

(3)

5. A car of mass 1200 kg, experiences a frictional force of 500 N when the engine force is 1400 N. Calculate the acceleration of the car.

(4)

6. In the following diagram the sky diver has a weight of 784 N.

a) Calculate the unbalanced force on the skydiver when air resistance is 544 N.

(1)

b) The mass of the skydiver is 80 kg. Calculate the acceleration of the skydiver when the air resistance is 544 N.

(3)

7. Newton's Third Law of motion can be quoted as "every action has a reaction".

a) When someone sits on a chair the action force is "downward force on chair", state the reaction force.

b) If the reaction force is "force of air on an aircraft engine", state the action force.

(2)

Dynamics and Space Homework Four

1. What is the value for gravitational field strength on planet Earth?

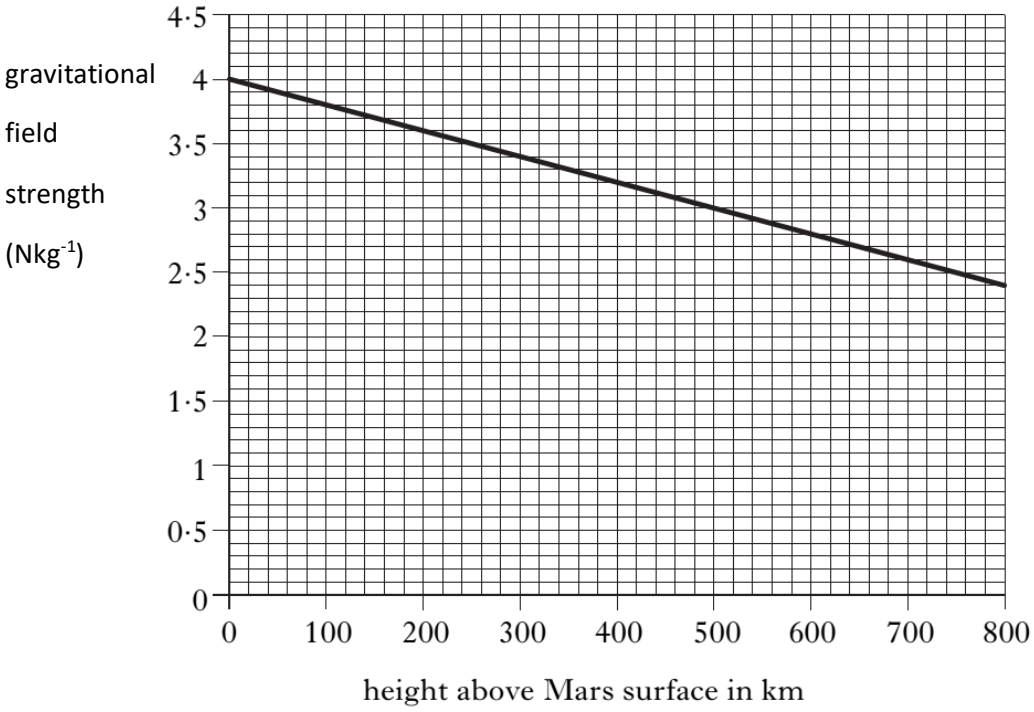
(1)

2. On planet X, the weight of an 8 kg mass was measured, using a Newton balance, and found to be 96 N. What is the gravitational field strength on planet X?

(3)

3. A space vehicle called Mars Lander was sent to the planet Mars.

The graph shows the gravitational field strength at different heights above the surface of Mars.



a) Before landing, the Mars Lander orbited at a height of 200 km above the surface of Mars. State the gravitational field strength at this height.

(1)

(b) The Mars Lander had a mass of 530 kg. Calculate the weight of the Mars Lander on the surface of Mars.

(3)

4. Copy and complete the following statements about satellites:

a) The moon is an example of (an artificial/a natural) satellite.

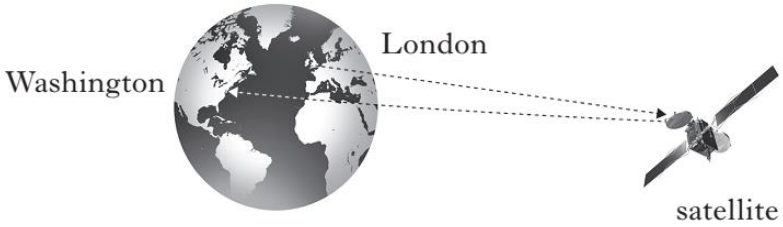
b) Satellites behave like projectiles. They have a constant horizontal (acceleration/speed) and a constant vertical (acceleration/speed).

c) The period of a geostationary satellite is (12/24) hours.

d) The altitude of a geostationary satellite is (36000/400000) km.

(5)

5. A television signal is to be transmitted from London to Washington.



The television signal is to be transmitted using microwaves.

a) State the speed of microwaves.

(1)

b) The television signal takes 0.068 s to travel from London to the satellite. Calculate the height of the satellite.

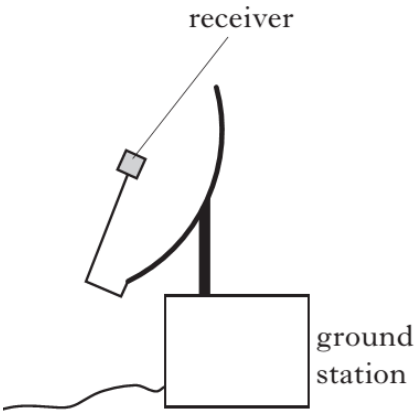
(3)

In Washington a ground station uses a curved reflector to receive the signals from the satellite.

c) Explain why the curved reflector should be as large as possible.

(1)

d) Copy and complete the diagram below to show the effect of this curved reflector on the received signal.



(2)

Dynamics and Space Homework Five

1. Name the terms A, B, C, D and E that are missing from the following table.

Term	Definition
A	A large object moving in an orbit round a star
B	A collection of galaxies.
C	A collection of stars, e.g. Milky Way
D	A luminous object powered by nuclear fusion, e.g. The Sun
E	A planet that is outside our Solar System.

(5)

2. A nebula, recently discovered by space scientists, is approximately 30000 light years from Earth.

Calculate the distance to this nebula in metres.

(3)

3. The table below gives information about some of the planets in our Solar System.

Planet	*Diameter* (kilometres)	*Distance from Sun* (million kilometres)	*Weight of one kilogram at surface* (newtons)	*Time to go around the Sun once* (years)	*Time for one complete spin* (in Earth days or hours)
Mercury	4800	58	4	0·25	59 days
Venus	12 000	110	9	0·6	243 days
Earth	12 750	150	10	1	24 hours
Mars	7000	228	4	1·9	25 hours
Jupiter	140 000	780	26	12	10 hours
Saturn	120 000	1430	11	30	10 hours
Neptune	50 000	4500	12	165	16 hours

a) State the name of the planet from our Solar System that has not been included in the list.

(1)

b) State the name of the planet which has the longest day.

(1)

c) State the name of the planet that has the longest orbit.

(1)

d) On which planet would a 4 kg mass have the greatest weight?

(1)

4. Read the following passage about a space mission to the moons of Jupiter.

> The spacecraft will use a new kind of engine called an ion drive. The ion drive will propel the spacecraft away from Earth on its journey to the moons of Jupiter, although for much of the journey the engine will be switched off.
>
> The spacecraft will first visit the moon Callisto.
>
> Callisto is only slightly smaller than the planet Mercury. Next, the spacecraft will visit Ganymede, the largest moon in the Solar System, before travelling on to Europa.
>
> The radiation around Europa is so intense that the spacecraft will not be able to operate for long before becoming damaged beyond repair.
>
> The spacecraft will eventually burn up in the atmosphere of Jupiter.

a) What is meant by the term Solar System?

(1)

b) How many moons are mentioned in the passage?

(1)

c) Put the following four objects in order from smallest to largest.

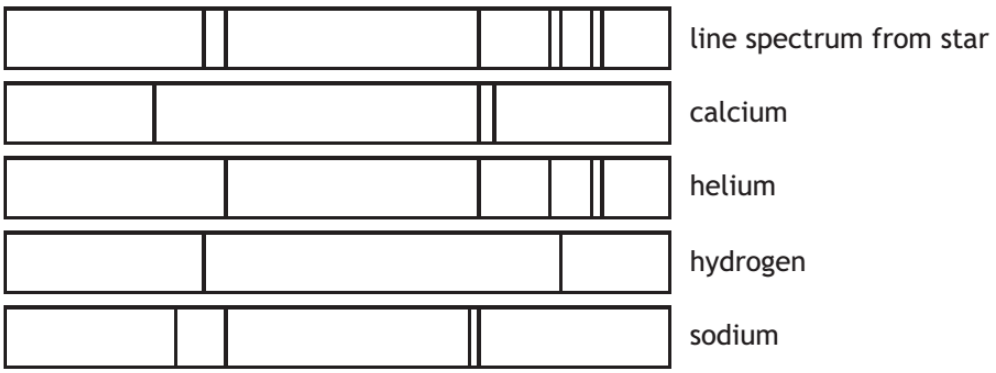
Callisto *Ganymede* *Jupiter* *Mercury*

(1)

d) State the energy change that takes place when the spacecraft enters the atmosphere of Jupiter.

(1)

5. Light from a star is split into a line spectrum of different colours. The line spectrum from the star is shown, along with the line spectra of some elements.



State the names of the elements that are present in the star.

(2)

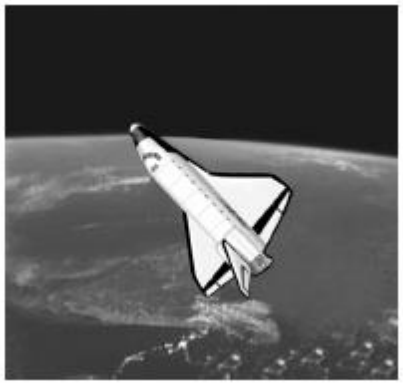
6. Copy and complete the following passage.

"The Big Bang theory is mainly about the (end/origin) of the universe. The universe is estimated to be 14 (million/billion) years old."

(2)

Dynamics and Space Homework Six

1. The spacecraft shown below is used to transport astronauts and equipment to a space station.



a) After re-entry the spacecraft lands on a runway like a plane. At the point of touchdown on the runway the spacecraft has a mass of 2×10^6 kg and is travelling at 100 ms^{-1}. Calculate the kinetic energy of the spacecraft at touchdown.

(3)

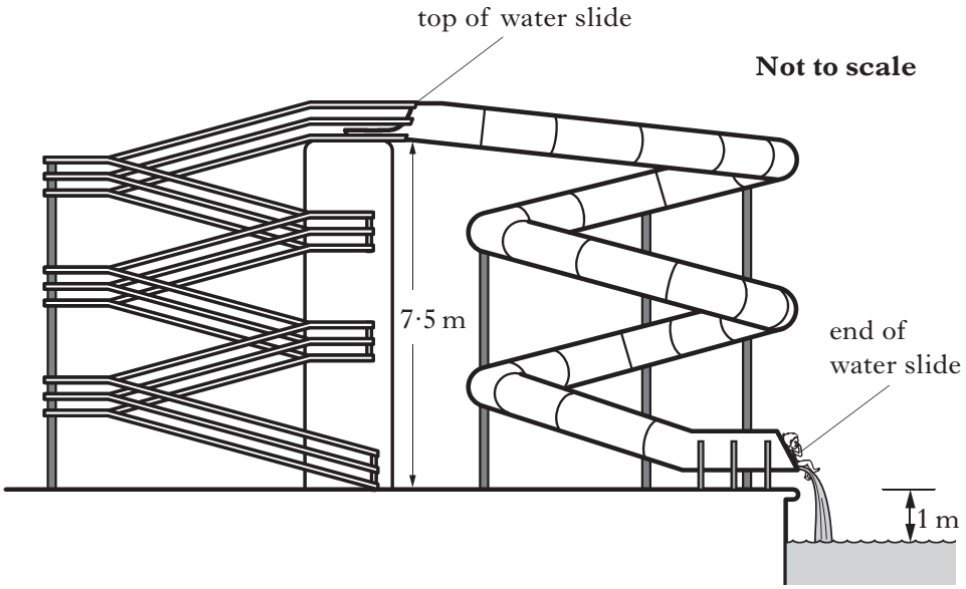
b) The spacecraft travels a distance of 2000 m on the runway before coming to rest. Calculate the force needed to bring the spacecraft to rest.

(3)

c) When the spacecraft is at rest, an aluminium component (mass 500 g) falls 5 m on to the runway. Calculate the gravitational potential energy lost by the component.

(3)

2. A child of mass 42 kg is playing on a water slide at a water park.



a) The child climbs 7.5 m to the top of the slide. Calculate the gain in gravitational energy of the child.

(3)

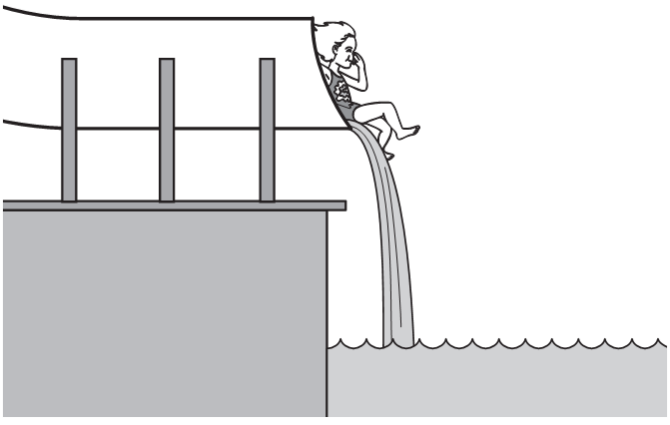
b) When sliding down an average frictional force of 15 N acts on the child. This causes 1050 J of heat energy to be produced. Calculate the length of the slide.

(3)

c) Calculate the speed of the child at the end of the slide.

(4)

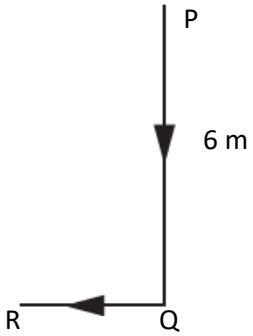
d) Sketch the path the child would take on leaving the end of the slide.



(1)

Dynamics and Space Homework Extras

1. A student walks around the edge of a Science lab by following the path shown below. Where P to Q is due south and Q to R is due west.



a) Determine the magnitude of the resultant displacement of the student from P to R.

(2)

b) Determine the direction of the resultant displacement of the student from P to R.

(2)

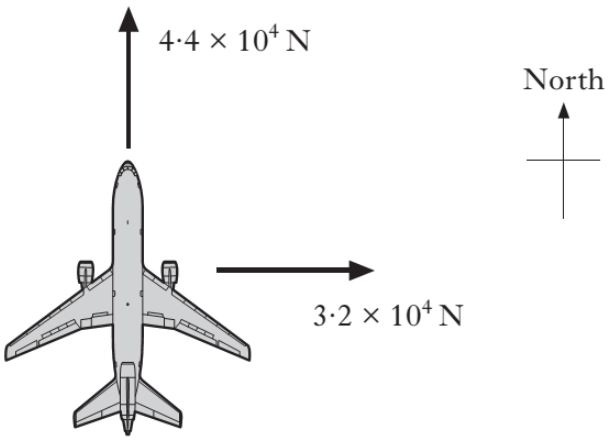
c) The student takes 10 seconds to follow the path shown. Calculate the average velocity of the student.

(3)

d) Show that the average speed for the student's journey is greater than the magnitude of the average velocity.

(3)

2. During a flight, an aircraft's engines produce a force of 4.4 x 10^4 N due North. The aircraft encounters a crosswind, blowing from West to East, which exerts a force of 3.2 x 10^4 N.



a) Determine the magnitude of the resultant force on the aircraft.

(2)

b) Determine the direction of the resultant force on the aircraft.

(2)

3. An aircraft is flying horizontally at 110 ms^{-1} when it drops supplies in a relief operation. The package takes 8 s to reach the ground.

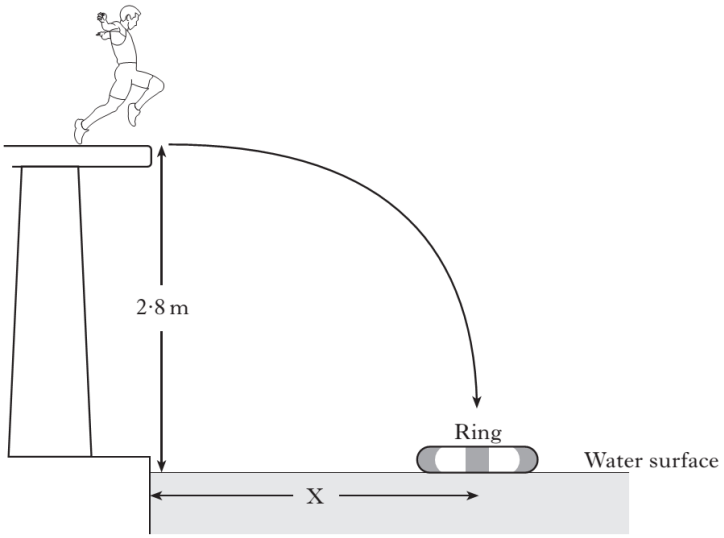
a) Calculate how far the package travels horizontally before hitting the ground.

(3)

b) Calculate the vertical velocity of the package when it reaches the ground.

(3)

4. In a TV game show contestants are challenged to run off a horizontal platform and land in a rubber ring floating in a swimming pool. The platform is 2.8 m above the water surface.



a) A contestant has a mass of 60 kg. They run off the platform with a horizontal velocity of 2 ms^{-1}. They take 0.75 s to reach the water surface in the centre of the ring.

i) Calculate the horizontal distance X from the poolside to the centre of the ring.

(3)

ii) Calculate the vertical velocity of the contestant as they reach the water surface.

(3)

b) Another contestant has a mass of 80 kg. They also land in the centre of the ring. Is the time taken for the second contestant greater, smaller or the same as the first contestant? Explain your answer.

(2)